TEACHING FORM 7 PHYSICS IN SECONDARY SCHOOLS IN FIJI: CURRENT DIFFICULTIES AND SOME PROPOSED SOLUTIONS

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Abstract

This paper is based on opening addresses given to secondary school Physics teachers participating in in-service workshops. While many of the problems identified and the solutions proposed may apply to science subjects generally, the paper deals specifically with Form 7 Physics in Fiji.

Introduction

The teaching of science subjects, particularly at the senior levels (Forms 5-7), has encountered many problems in secondary schools in Fiji, as well as in the region generally, for many years. The problems are especially prevalent for subjects such as Physics and Mathematics, particularly at the Forms 6 and 7 levels.

These problems have been aggravated in the past 10 years, during which time hundreds of qualified and experienced teachers have left Fiji to settle overseas. According to figures obtained from the Bureau of Statistics (Chetty, 1996), between 1987 and 1995, 1,399 teachers emigrated from Fiji. This is a very significant proportion of the total teacher workforce.

The process of emigration has resulted in a significant shortage of qualified and experienced teachers, particularly science teachers, at the secondary school level. Dr. Vijay Naidu, of the University of the South Pacific noted in a public lecture that "The shortage of qualified and experienced teachers has seriously affected the standard of education provided at all levels of the system. This is specially the case for rural schools."

Teaching and Learning of Science Subjects

Science subjects, because of their very nature, provide particular challenges for both the teachers and the students. Because the subject matter, as a general rule, keeps on evolving with new developments fuelled by research and technology, the teachers have to keep up with these developments in order to carry out their task satisfactorily. Therefore, teachers need to continue learning as well in order to help students to learn properly.

In addition, the teaching of science subjects necessitates the use of experiments and demonstrations to help students to understand the concepts. Thus teaching these subjects means not only classroom lectures but laboratory-based practical classes where students learn about the subject matter by carrying out experiments or by teachers demonstrating experiments. Students learn better if they can themselves 'observe' things happening, such as, being able to observe that the period of a simple pendulum is independent of its mass.

Need for Laboratory Classes

Theory and practice should go together as far as possible. Science teaching involves passing on knowledge which was created by the use of extensive laboratory experimentation. Students must learn that most of the knowledge that they gain by the study of science has come through experimentation. Thus they themselves should do experiments in order to see how these can be performed.

The other desirable end result is that students can understand and actually have a good feel for how the subject has developed and how it will continue to develop. An appreciation of the scientific method is obviously crucial for students. By understanding the principles behind the experiment, students learn and understand the importance of measurements. At the same time, they also understand the importance of equipment and materials. An appreciation of the principles and operation of scientific equipment is fundamental to a good understanding of the subject.

Types of Experiments/Demonstrations

The experiments that are prescribed by the Curriculum Development Unit (CDU) for any subject at a particular level, are obviously meant to be carried out by the students. However, in reality, this is rarely achieved due to a number of reasons. The experiments reflect the contents of the subject and are meant to reinforce the concepts introduced in the theoretical sections. Thus, a certain number of experiments are prescribed, chosen in a manner with regard to the equipment and materials needed, which would allow schools to carry them out. In the event that a school does not have enough equipment to enable all the students to do the experiments in small groups (two or three each), the teacher could demonstrate the experiment to the whole class. Again, for various reasons, even this is not done, or if it is, it is done in a rather perfunctory manner and students are not asked to write a report.

The experiments generally consist of two-hour exercises, with the teachers assembling the apparatus and the students carrying out the experiment according to instructions in the experimental handout or laboratory manual. Some of the common experiments consist of those in mechanics, statics, energy transformation, momentum conservation, forces, magnetic forces, electrostatics, and optics. The practical report that the students are supposed to write and which should be assessed consists of several sections which include the aim(s), equipment used, method, results, discussion and conclusions.

Constraints on Good Science Teaching-Systematic and Self-Imposed

General Problems

There appear to be a few problems which are common to most schools teaching Form 7 science. These include lack of resources (suitable funding for buildings, equipment, teaching aids, books and qualified and experienced teachers) as well as a lack of will to acquire resources.

Most of the schools in Fiji are owned and operated by communities and churches (Ministry of Education, Science and Technology: Annual

Report, 1995). In 1995, only 13 secondary schools (out of 148) were actually owned and operated by the government. Because of this situation, schools may not be adequately funded or resourced. Indeed, the needs of the schools, as perceived by the community or church-based management, may not necessarily be in accord with those of the staff and students. Such schools also naturally want to have a say in all aspects of their operation: the hiring and firing of staff, the admission of students, how the school fits into the community and so on. The Ministry of Education may have views which may not always coincide with those of the school management. This can, and frequently does, create problems.

Also, being community-funded and operated, the management needs to raise money for the schools over and above that obtained through school fees. Thus, quite often, students and staff are expected to raise funds for various purposes through efforts at the school and community levels. Some schools tend to go overboard with this activity at the expense of academic activities.

Lack of Suitably Qualified Teachers

There can be no denying that many schools lack suitably qualified teachers in various subjects, but perhaps more so in science.

Lack of Facilities for Practical Work in Science Subjects

There is clear evidence that many schools, particularly in rural areas, lack decent laboratories and equipment to carry out practical work. The quality and range of laboratory equipment is rather limited in comparison with the equipment that is available at the University of the South Pacific. Many schools lack basic equipment and even when they have it, there is not enough for more than one demonstration set-up.

Lack of Motivation on the Part of Teachers

It is difficult to ignore comments and criticisms from school principals, the Education Ministry, students, other teachers, CDU officials and the

general public that there is a lack of motivation on the part of teachers to teach properly and with the best interests of students at heart. There appears to be some justification for such criticisms. Certainly it is true that some teachers do not wish to be transferred to schools that have a reputation for producing poor academic results. Equally, there may be some substance to the claim that a few teachers take a transfer to a school merely for promotion rather than to strive towards excellence for the schools. Some teachers have also been severely criticised for downright unprofessionalism for not completing the required syllabus or for not doing enough in preparing students for final examinations, and so on.

Perception that the Facilities for Laboratory Work are not Essential

Many schools do not consider science practicals as important. This is due to a lack of understanding of what science teaching involves. Principals and school management with non-science backgrounds, are often of the view that students can learn science, as they do other subjects, through classroom teaching only. Consequently they do not give as much prominence and support to the teaching of science subjects as these deserve. This quite often translates into a lack of funding for equipment and materials for practical work. This is often compounded by the perception that having some equipment is sufficient as students could be given demonstrations.

Examination-Driven Teaching in Schools

It is an unfortunate fact that many schools are examination-driven. That is, schools, by and large, consider the passing rate in external examinations as the most important aspect of school activities and encourage maximum pass rates. This leads to teachers and students thinking along these lines and teaching and learning merely for the purpose of passing external examinations. This is obviously a very unsatisfactory state of affairs as other aspects of learning and teaching are sacrificed, ignored or paid lip-service to. One aspect of this is the reorganisation of laboratory practical work, wherein, only those practicals that may be examined (based on previous years' examination papers) are covered, and as demonstrations rather than as individual or

group experiments. Therefore, students do not gain the experience and confidence of carrying out experiments for themselves, which would be extremely valuable for them.

Lack of Continuous Assessment

Another aspect of the current teaching method is the lack of any continuous assessment. The only assessment done is that of the performance in final examinations, whether internal or external. This can be problematic, particularly with respect to the students' understanding and appreciation of laboratory experiments. If students are assessed on a continuous basis, with a fraction of the final marks contributed by the performance during the course of their studies, this may significantly lift many students' final performance.

Overcoming Constraints

Use of Facilities/Resources at the University of the South Pacific

The University of the South Pacific has generally superior facilities/resources (equipment, laboratories, academic and technical staff, audio/visual equipment, books and journals, library, etc.) compared to secondary schools. Schools have the opportunity to utilise these facilities/ resources in a number of ways. Indeed, some schools do take advantage of this, particularly schools in the Suva/Nausori/ Navua areas. One way to take advantage of the U.S.P. facilities is to borrow equipment from the Physics Department for demonstrating experiments in schools. Another is to bring students to the Physics Department to carry out experiments which cannot be done in the schools due to a lack of equipment and/or expertise. Other schools take advantage of the well-equipped library at the U.S.P.

Another valuable organisation whose expertise could be utilised is the South Pacific Physics Society, based in the Physics Department of the School of Pure and Applied Sciences of the U.S.P. The society has conducted numerous workshops for Form 7 Physics students and teachers. It has also provided resources such as old text books and

organised Physics quiz competitions at various levels for secondary schools. The Society is ready to provide whatever assistance is needed, particularly for Form 7 Physics teachers and students.

Developing Basic Equipment in Schools/ Workshops

There is some scope for designing and developing some basic equipment and components in the schools themselves or in nearby workshops. Many schools lack some very basic apparatus or components such as masses, springs, meter rules, and so forth. Basic components can be constructed in schools using scrap material obtained from workshops and garages. Additionally, many schools have very old equipment which has seldom, if ever, been used. These can be repaired and maintained for carrying out various experiments.

Use of Videos and Computers to Simulate/ Understand Experiments

Schools can also use video packages and computers to teach science and to simulate experiments which cannot be done in schools. Many science teaching packages are available as videos, computer diskettes and CD-ROMS. Computers can also be used for teaching, by using Computer-Assisted Learning packages. Even if video packages, showing various experiments, are not readily available or are too expensive, schools could request the Curriculum Development Unit (CDU) to make available certain experiments on video tapes. Also teachers from such schools can visit well-resourced schools (or other educational institutions, such as the U.S.P.) and record experiments on video tape for use in their schools. Equipment such as a video camera can be readily hired.

Breaking the Examination-Driven Mode of Teaching

As mentioned above, many schools appear to fall in the unfortunate and undesirable situation of teaching for the sake of getting students to pass external examinations. Many teachers admit that the schools expect them to achieve a high pass rate for the students they teach. Indeed, in some cases, a teacher's future at a school is dependent on the pass

rate of his/her students in external examinations. Therefore from the beginning the teachers' target is not "proper" teaching but maximum pass rates. Some examples of 'improper' teaching methodology include teachers giving copious notes (largely photocopies from various textbooks) getting students to do lots of 'homework problems' without giving sufficient background or explanations as to the fundamental theory behind the subject matter, getting students to do extensive reading without giving them an opportunity to ask questions, giving them problems that are very similar to the ones that have appeared in previous examinations and generally discouraging students from asking questions in class because this would mean less time for syllabus coverage.

If teachers and schools adopt the attitude that students should be taught properly, i.e. if teachers make a genuine effort to cover the syllabus thoroughly and to ensure that laboratory practicals are carried out and understood, and not simply teach to pass examinations, there surely will be a situation that would ensure that laboratory experiments for science subjects are carried out, irrespective of whether or not these will be examined.

Use of Old and Damaged Equipment/Materials

For various reasons many schools acquire a lot of equipment and materials that cannot be used. These include donation of equipment from various sources, equipment brought by teachers (particularly peace corps volunteers) and their subsequent transfer, and non-use of some equipment because the new teacher(s) is not confident or is scornful of old equipment. In my visits to many secondary schools in Fiji, I have come across equipment and materials which are merely collecting dust and rusting. Teachers could be persuaded to spend some of their time cleaning the equipment and making it workable.

Pro-Active Role by Schools and Teachers

Schools (through the teachers) often complain about the lack of equipment, lack of support by schools for laboratory-based teaching and also about the Education Ministry and the CDU in particular, as being

reasons for the unsatisfactory situation that prevails with respect to the laboratory experiments for the science subjects. However, while their complaints may be legitimate, they should take a more pro-active role in order to improve the situation. There is, for instance, scope for them to approach the CDU themselves, to keep on putting pressure on the school management for decent equipment and other resources and pressure on the Education Ministry through their trade union and other means.

Conclusion

This paper has focused on the problems pertaining to the teaching of Physics at the Form 7 level in secondary schools in Fiji and, in particular, the teaching of the laboratory component of the Physics prescription. Various problems have been highlighted, including those of equipment and materials shortage, lack of appropriately qualified teachers and the problems of school, teacher and student expectations. It has also proposed ways of remedying or, at least alleviating, some of these problems.

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